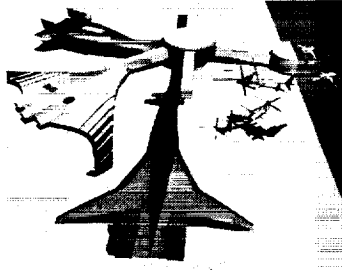


CONF REPORT / 54 / IN / 03

Aviation System Technology Advanced Research Program - AvSTAR

## A Vision of the Future ATM System

September 21, 2000



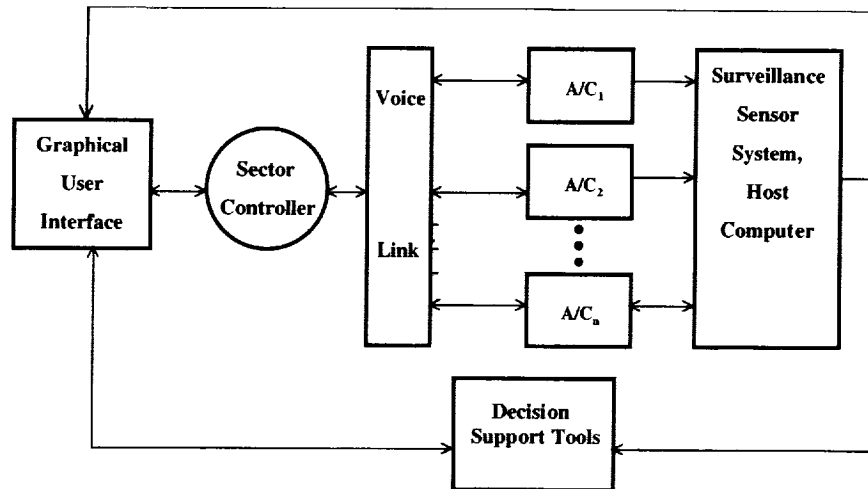
Dr. Heinz Erzberger  
Senior Scientist for ATM  
Ames Research Center

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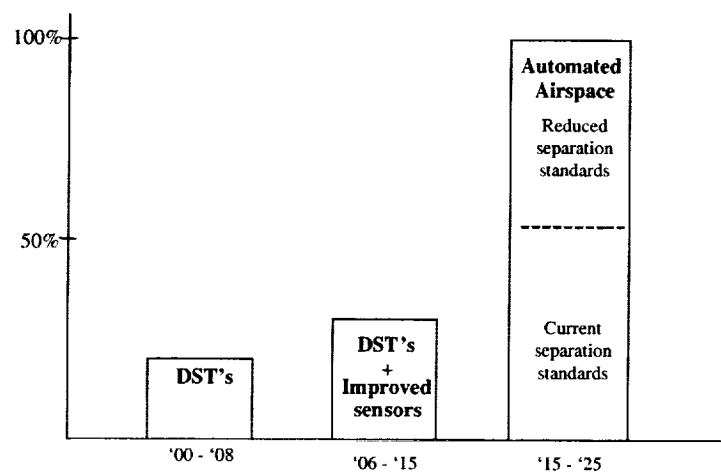
### **Large Increases in Capacity, Safety and Efficiency Require a New Approach**

- Air traffic growth is increasingly constrained by the capacity limits of sectorized control, wherein a controller is responsible for separation assurance, planning, communications, coordination, etc.
- Capacity gains through re-sectorization and sector size reduction have reached the point of diminishing returns.
- Decision Support Tools provide modest gains but can't circumvent basic controller workload limits.
- Constraints that limit flight efficiency can't be reduced at high traffic density because that would further exacerbate the controllers workload problem.
- The inevitability of human error limits further improvements in safety with current procedures.
- Potential of reduced separation can't be fully exploited because of workload and reaction time limits with controllers performing current duties.

### Current ATM System



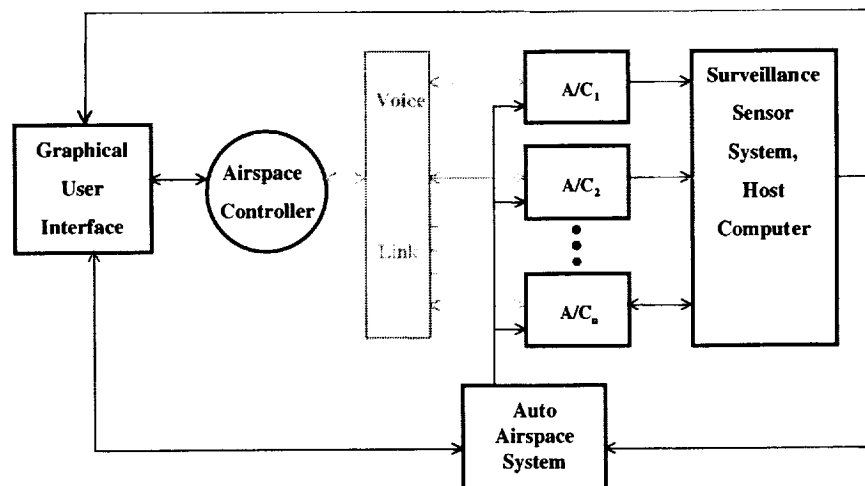
### ATM Performance Gains



## Automated Airspace Operations

- Sector controllers are “liberated” from the responsibility of separation assurance and are “promoted” to the new role of airspace controller.
- Several traditional sectors are combined into super-sectors, each managed by an airspace controller.
- Conflict detection and resolution is fully automated and distributed between ground-based and airborne systems connected via data link.
- Sequencing and spacing control in the terminal area is fully automated on the ground and is executed via data link.
- Voice communication between airspace controller and pilots will be available to handle special needs, i.e. special pilot request, emergencies, loss of data link.
- Access to automated airspace will be restricted to equipped aircraft.
- Automated airspace can revert to conventionally controlled airspace during low demand periods.

## Automated Airspace System



### **Development Challenges**

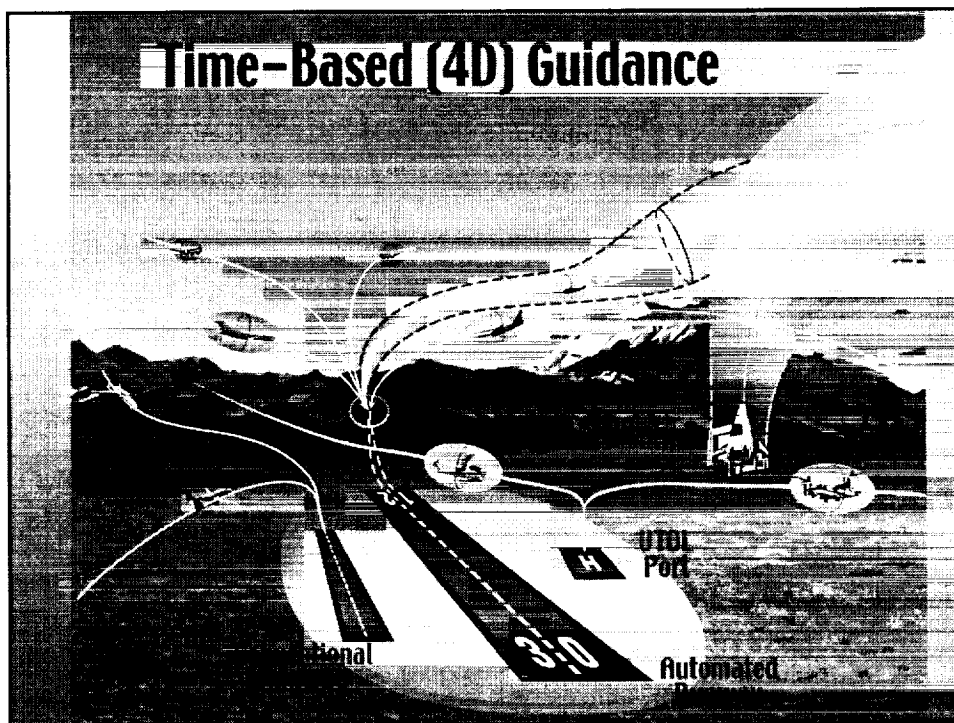
- Gaining acceptance of concept by operators, controllers and the public.
- Design of system architecture that has multiple safety nets to protect users against various types of failures.
- Automated failure detection and reconfiguration of system to operate in a degraded mode.
- Roles and responsibilities of airspace controllers.
- Design of the interface between airspace controller and system element; retaining the human-centered design while changing the role of the human.

### **Development Challenges (cont.)**

- Transitioning from manual to automated airspace operations.
- Providing airspace and runway access for unequipped aircraft
- Upgrading the CTAS algorithms and software to level of performance required for autonomous operation.
- Establishing minimum equipment standards for airspace users.
- Verification, validation and testing of concept.

## Approaches to Automated ATC

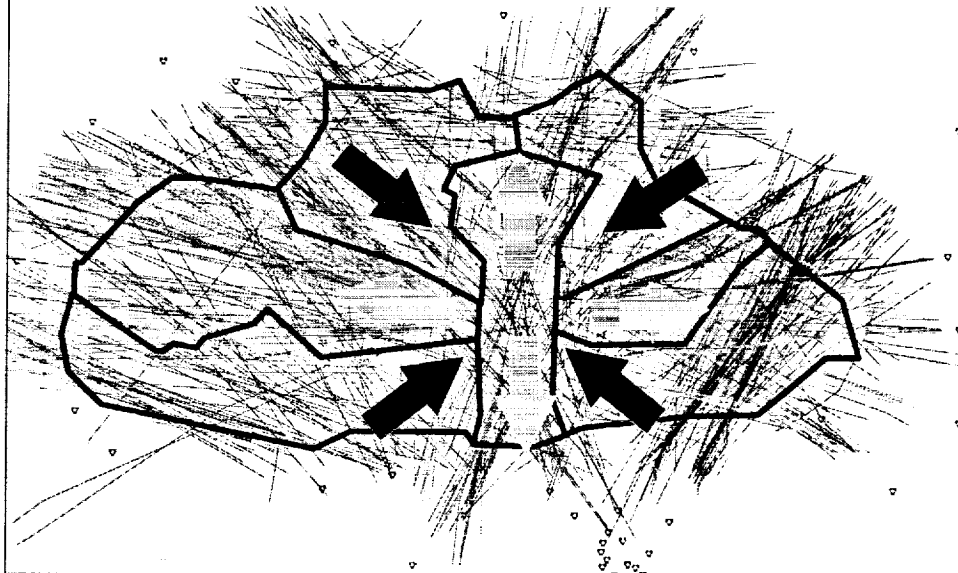
- Time-based (4D) Guidance
- Self-Separation and advanced TCAS
- Automated Airspace

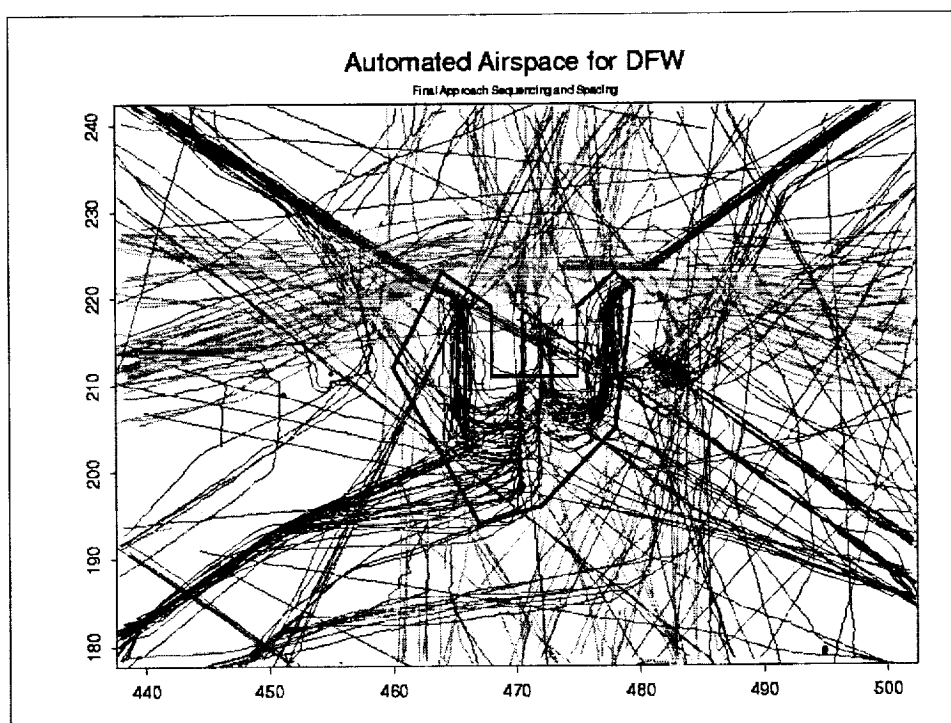
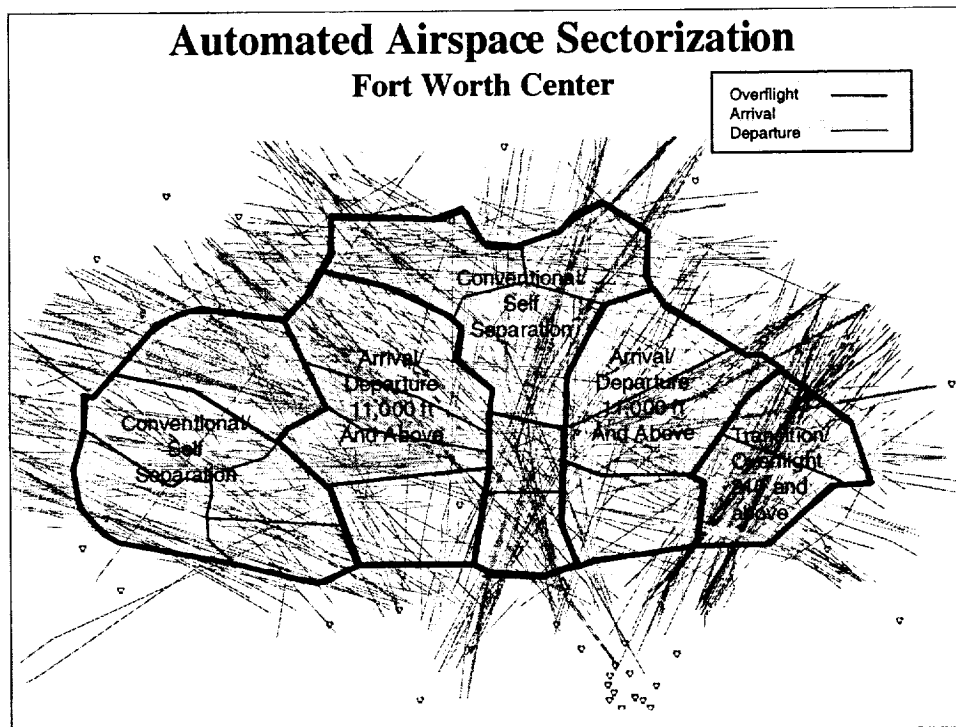


## **Types of Automated Airspace**

- Self separation airspace
- High altitude transition airspace: mixed climbing, descending and over-flights
- Arrival and departure management airspace
- Final approach sequencing and spacing airspace

## **Fort Worth Center Traffic Flows FL240 and above**





### **Benefits of Super Sector**

- Boundaries unconstrained by current center boundaries.
- Elimination of trajectory constraints imposed by conventional sector structure and altitude stratification.
- Reduction of handoff coordination.
- Shared airspace for arrivals, departures and overflights allows flexibility in use of airspace and routes.
- Unified airspace of super sectors enables increasing the range and effectiveness of conflict resolution.
- Increased controller productivity.

### **Steps Toward Automated Airspace**

- Complete deployment of decision support tools for critical ATM specialties (2010).
  - DST technology is the foundation for Automated Airspace.
- Introduce Distributed Air Ground procedures and improved sensors (2006).
  - When combined with DST's, this begins the process of changing sector controller roles and responsibilities.
- Build high performance and secure air-ground data link required to support automated airspace operation (2012).
- Evaluate prototype automated airspace system in selected high altitude airspace (2015).
- Install in high density on route airspace (2017).
- Install in high density terminal areas (2020).